CLAIMS OF TEXT accompanying IPER (pgs 15-21)

CLAIMS

1. A thermally curable adhesive composition which comprises:

(a) a thermosetting polymer, or a monomer which is polymerisable to yield a thermosetting polymer, said polymer being crosslinkable when subject to the action of a chemical crosslinking agent; and

(b) a chemical crosslinking agent for said polymer, the crosslinking agent having fluxing properties and exhibiting no reactivity, or exhibiting very restricted reactivity with the polymer without the action of a catalyst and/or heat; and

which composition is thermally curable when heated to temperature range extending from the liquidus temperature of the alloy Sn/Pb 60/40 up to the liquidus temperature of the alloy Sn/Pb 3/97 and in the presence of a catalyst for the crosslinking of the polymer with a crosslinking agent and is storage and reaction stable in the absence of such catalyst and at temperatures inthe range of from 20-25°C.

2. A composition according to claim 1, wherein the chemical crosslinking agent is solid at ambient temperature.

3. A composition according to claim 2, wherein said chemical crosslinking agent is selected from polyacids, polyanhydrides and hydrazides which are insoluble in the monomer or polymer until heated to soldering temperature.

4. A composition according to claim 3, wherein the polyacid is selected from polymers containing two or more carboxyl groups and di- and polycarboxylic acids and di-and polyanhydrides.

5. A composition according to claim 4, wherein the polycarboxylic acid is a C_8 or greater dicarboxylic acid.

6. A composition according to claim 3, wherein the hydrazide is a monohydrazide, dihydrazide or polyfunctional hydrazide.

Sub A3 7. A composition according to any one of claims 3 to 6, wherein the crosslinking agent contains a dihydrazide and/or a dicarboxylic acid.

8. A composition according to claim 7, wherein the crosslinking agent contains adipic dihydrazide and/or dodecanedioic acid.

9. A composition according to claim 4, wherein the crosslinking agent is a styrene acrylic acid copolymer.

Sub A4 10. A composition according to any preceding claim, which has a thermosetting polymer - solid crosslinking agent/flux content in which there are from 30 to 70% by weight of thermosetting polymer and from 70 to 30% by weight of solid crosslinking agent/flux.

11. A composition according to Claim 10, wherein said thermosetting polymer content is from 50 to 60% by weight and said solid crosslinking agent/flux content is from 50 to 40% by weight of the total amount of thermosetting polymer and crosslinking agent/flux.

12. A composition according to any one of claims 1 to 11, wherein said polymer is an epoxy resin.

13. A composition according to claim 12, wherein said polymer is a B-staged epoxy resin.

14. A composition according to claim 13, wherein the said polymer is a diglycidyl ether of bisphenol A.

15. A composition according to claim 14, wherein the said polymer is based on a tri- or tetrafunctional epoxide or a difunctional cycloaliphatic epoxide or a mixture of two or more such epoxides.

16. A composition according to any preceding claim, which additionally comprises an acid flux which is liquid at temperatures below 100°C.

17. A composition according to Claim 16, wherein the acid flux is liquid at temperatures of from 20 to 25°C.

18. A composition according to Claim 16 or 17, wherein the acid flux is a monocarboxylic acid, preferably containing at least 8 carbon atoms.

19. A composition according to Claim 18, wherein the acid flux is a versatic acid, capric acid, caprylic acid, lauric acid, stearic acid or palmitic acid.

20. A composition according to any one of Claims 16 to 19, which has a thermosetting polymer-flux content in which there are from 30 to 70% by weight of thermosetting polymer and from 70 to 30% by weight of flux, which flux is, in turn, made up from 80 to 97% by weight of said solid crosslinking agent/acid flux and from 20 to 3% by weight of said acid flux.

21. A composition according to Claim 20, which has a thermosetting polymer-flux content in which there are from 50 to 60% by weight of thermosetting polymer and from 50 to 40% by weight of flux, which flux is, in turn, made up from 85 to 95% by weight of said solid

crosslinking agent/flux and from 15 to 5% by weight of said acid flux.

22. A composition according to any preceding claim, which additionally comprises a latent reaction catalyst selected from tertiary amines and imidazoles and metallic salts.

23. A composition according to Claim 22, wherein the imidazole is phenyl imidazole.

24. A composition according to Claim 22, wherein the tertiary amine is constituted by self catalysing tertiary amine groups substituting the reactive monomer or polymer.

25. A composition according to Claim 24, wherein the reactive monomer is a tertiary amine-substituted trifunctional or tetrafunctional epoxide.

26. A composition according to Claim 22, wherein the metallic salt is tin octanoate, dibutyl tin dilaurate, ferric acetylacetonate, and cobalt (III) acetylacetonate.

27. A composition according to any preceding claim which further comprises a thermally conductive filler.

28. A composition according to Claim 27, wherein said filler reduces thermal expansion of the composition.

29. A composition according to Claims 27 and 28, wherein the filler is constituted by nominally 5μ spherical ceramic beads or hollow spheres.

30. A composition according to Claim 27, wherein the

filler is a ceramic or glass ceramic powder comprising spherical particles with diameters in the range from 0.1 to 25μ, preferably 1-15μ.

31. A composition according to Claim 27, wherein the filler is a ceramic or glass ceramic powder consisting essentially of monodisperse spherical particles having a single diameter in the range from, 0.1 to 25μ, preferably 1-15μ.

32. A composition according to Claim 27, wherein the filler is a thermally conductive ceramic powder.

33. A composition according to Claim 32, wherein the ceramic powder is selected from SiO_2, MgO, Al_2O_3, TiO_2 /ZnO, barium sulphate and diamond dust.

34. A composition according to Claim 27, wherein the ceramic powder has a negative coefficient of thermal expansion.

35. A composition according to Claim 34, wherein the ceramic material is aluminium lithium silicate.

36. A method of producing an electronic device which comprises opposing an electrical component having a surface carrying a plurality of electrical terminations, each termination including a solder bump, and a component-carrying substrate having a plurality of electrical terminations corresponding to the terminations of the electrical component, with a thermally curable adhesive composition being applied to said surface of the electrical component and/or to the substrate, bringing the electrical component and substrate into contact at elevated temperature and thereby soldering the electrical component to the

substrate and simultaneously achieving encapsulation thereof in thermoset polymer produced in situ from monomer or polymer in the adhesive composition, in which method (1) the thermally curable adhesive composition comprises:

(a) a thermosetting polymer, or a monomer which is polymerisable to yield a thermosetting polymer, said polymer being crosslinkable when subject to the action of a chemical crosslinking agent; and

(b) a chemical crosslinking agent for said polymer, the crosslinking agent having fluxing properties and exhibiting no reactivity, or exhibiting very restricted reactivity with the polymer without the action of a catalyst and/or heat; and

which composition is thermally curable when the material of the solder bump is molten and in the presence of a catalyst for the crosslinking of the polymer with the crosslinking agent and is storage and reaction stable in the absence of such catalyst and at temperatures in the range of 20-25°C and (2) catalysis of crosslinking of the thermally curable adhesive is achieved by metal oxide removed from metal surfaces by the fluxing composition and/or salts formed by reaction between metal oxide and crosslinking agent.

37. A method as claimed in Claim 36, wherein the thermally curable adhesive composition is applied to one and/or both of the said electrical component and said substrate prior to bringing the two together.

38. A method as claimed in Claim 36 or 37, wherein no fluxing agent is applied to either the surface of said electrical component carrying the electrical terminations or to said substrate prior to application of the curable adhesive composition.

39. A method as claimed in any one of Claims 36 to 38, wherein the thermally curable adhesive composition is applied to dies, which are either in wafer form or as separate discrete devices.

40. A method as claimed in any one of Claims 36 to 39, wherein the thermally curable adhesive composition is applied by screen printing, stencil printing, dispensing or spinning.

41. A method as claimed in any one of claims 36 to 40, wherein the thermally curable adhesive composition is a composition as claimed in any one claims 1 to 35.

42. A method as claimed in any one of Claims 36 to 41, wherein the thermally curable adhesive composition is applied in B-stageable form and B-staged in situ.